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TELECOMMUNICATIONS TEST PLUGS HAVING TUNED NEAR END CROSSTALK

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. provisional patent application serial number 60/417,812 filed October 10, 2002, the entire contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] Improvements in telecommunications systems have resulted in the ability to transmit voice and/or data signals along transmission lines at increasingly higher frequencies. Several industry standards that specify multiple performance levels of twisted-pair cabling components have been established. The primary references, considered by many to be the international benchmarks for commercially based telecommunications components and installations, are standards ANSI/TIA/EIA-568-A (/568) Commercial Building Telecommunications Cabling Standard and 150/IEC 11801 (/11801), generic cabling for customer premises. The standards provide for differing levels of performance, and have been assigned to differing categories. For example, Category 3, 4 and 5 cable and connecting hardware are specified in both /568 and /11801, as well as other national and regional specifications. In these specifications, transmission requirements for Category 3 components

are specified up to 16 MHZ. Transmission requirements for Category 4 components are specified up to 20 MHZ. Transmission requirements for Category 5 components are specified up to 100 MHZ. Category 5e standards have been adopted and Category 6 standards will be published in the new future.

[0003] The above referenced transmission requirements specify limits on near-end crosstalk (NEXT). Under TIA 568A, the contacts in a telecommunications plug are numbered sequentially 1-8 and are arranged in pairs represented by contacts 1-2, 3-6, 4-5 and 7-8. The TIA standards establish limits on pair-to-pair crosstalk for both category 5e and category 6.

[0004] Manufacturers of telecommunications connectors such as plugs and outlets are faced with the task of testing telecommunications connectors to meet standards such as category 5e and category 6. For example, outlets must be tested with plugs having various NEXT levels so that performance of the outlet is confirmed across the spectrum of category 5e and category 6 components. Unfortunately, providing test plugs with NEXT values across the category 5e and category 6 spectrum currently requires numerous test plugs and is time consuming.

[0005] Test plugs are currently terminated using a number of wires that enter a plug housing and are terminated at insulation displacement contacts (IDCs). The wires are originally arranged in twisted pairs, untwisted and routed into the plug. The untwisting causes variability between test plugs and is difficult to control. The particular arrangement of the wires after untwisting creates difference in NEXT values between pairs and thus makes it difficult and time consuming to produce test plugs having specific NEXT values between pairs. Given these difficulties, as many as 18 different test plugs may be needed to

establish the needed NEXT values between pairs for testing both category 5e and category 6.

SUMMARY OF THE INVENTION

[0006] An embodiment of the invention is a set of telecommunications test plugs. A first test plug has a first test plug printed circuit board having circuit traces for establishing first predefined near end crosstalk between at least two of pairs of wires. The first predefined near end crosstalk is at a first level of a first defined range. A second telecommunications plug has a printed circuit board having circuit traces for establishing a second predetermined level of near-end crosstalk. The circuit traces are positioned to establish second predefined near end crosstalk between at least two of pairs of wires. The second predefined near end crosstalk is at a second level of a second defined range.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] Referring now to the drawings wherein like elements are numbered alike in the several FIGURES:

[0008] FIGURE 1 illustrates components of a plug in one embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0009] FIGURE 1 illustrates components of a plug 100 in one embodiment of the invention. The plug 100 includes a plug housing 102 and a plug board 104. The plug board is a printed circuit board including wire connection points 106 such as plated through holes for receiving wires from a twisted pair cable. The wires may be soldered in through holes

106. Alternatively, the plug board 104 may include insulation displacement contacts for engaging the wires.

[0010] A number of primary circuit traces 108 lead from wire connection points 106 to contact pads 110. The contact pads 110 are conductive regions on the plug board 104 and are aligned with slots 112 on the plug housing 102. Electrical contacts may be soldered to contact pads 110 and extend through slots 112. These electrical contacts will make electrical contact with pins in an outlet. The pair arrangements are shown on the plug board depicting pairs 1-2, 3-6, 4-5 and 7-8, where pair 3/6 is referred to as a split pair because pair 4/5 is interposed between pair 3/6.

[0011] The plug board 104 also includes secondary circuit traces 114. The placement of the primary circuit traces 108 and the secondary circuit traces 114 controls the amount of crosstalk between pairs so that NEXT levels between pairs is set to predefined values.

[0012] To effectively test telecommunications components for compliance with category 5e and category 6 requirements, an embodiment of the invention uses three test plugs for category 5e and five test plugs for category 6 tuned in the following manner.

Test Plug #1 – Category 5e

Pair combination	Level	NEXT Limit dB
3/6 – 4/5	low	34.4
1/2 - 3/6	low	42
3/6 – 7/8	low	42
1/2 – 4/5	low	50
4/5 – 7/8	low	50
1/2 – 7/8	low	60

Test Plug #2 – Category 5e

Pair combination	Level	NEXT Limit dB
3/6 – 4/5	high	37.6

Test Plug #3 – Category 5e

Pair combination	Level	NEXT Limit dB
1/2 - 3/6	high	50
3/6 – 7/8	high	50
1/2 – 4/5	high	70
4/5 – 7/8	high	70

Test Plug #1 – Category 6

Pair combination	Level	NEXT Limit dB
3/6 – 4/5	low	36.4

Test Plug #2 – Category 6

Pair combination	Level	NEXT Limit dB
3/6 – 4/5	middle	37

Test Plug #3 – Category 6

Pair combination	Level	NEXT Limit dB
3/6 – 4/5	high	37.6

Test Plug #4 – Category 6

Pair combination	Level	NEXT Limit dB
1/2 - 3/6	low	46.5
3/6 – 7/8	low	46.5
1/2 – 4/5	low	57
4/5 – 7/8	low	57
1/2 – 7/8	low	60

Test Plug #5 – Category 6

Pair combination	Level	NEXT Limit dB
1/2 - 3/6	high	49.5
3/6 – 7/8	high	49.5
1/2 – 4/5	high	70
4/5 – 7/8	high	70

[0013] The desired NEXT levels are obtained by adjusting the position and/or dimensions (e.g. length, width, thickness) of the primary circuit traces 108 and the secondary circuit traces 114. The primary circuit traces 108 may be characterized as transmitting the information signal (e.g., voice, data) from the wire connection points 106 to the contact pads 110. The secondary circuit traces 114 are shunt or stump connections that do not provide a connection for the information signal. The primary circuit traces and/or the secondary circuit traces provide reactive (e.g., inductive and/or capacitive) coupling between signal paths corresponding to twisted pairs. By adjusting the location and/or dimensions of the primary

circuit traces and/or the secondary circuit traces, the desired NEXT levels may be obtained to create the three category 5e test plugs and the five category 6 test plugs described above.

[0014] Using a plug board 104 to establish the desired NEXT levels between pairs reduces, if not eliminates, the variability in existing plugs due to placement of wires. The circuit traces on the plug board may also be adjusted to provide specified return loss, far end crosstalk (FEXT) and balance.

[0015] The NEXT limits provided above for the various test plugs are exemplary and are not intended to limit the invention. An embodiment of the invention provides test plugs having NEXT values adjusted to different levels within a standards-defined range. This allows the telecommunications components to be tested across the standards-defined range with a minimum number of test plugs.

[0016] The plug 100 may also be used as a plug available to consumers, rather than solely as a test plug. The plug would be tuned to meet certain NEXT levels between pairs depending on consumer requirements. For example, if a consumer needed a plug marginally better than category 5e, the plug could be tuned to meet the low end NEXT requirements of category 6. Alternatively, the plug could be tuned to meet the high level NEXT requirements of category 6. The use of plug board 104 reduces variability is terminating wires in the plug which leads to less rework of plugs by the manufacturer and fewer failures in the field.

[0017] Although the plug 100 has been described for use with a cable having eight wires arranged in four pairs, it is understood that the plug board 104 may be configured for use with any number of pairs such as 1, 2, 3 or 5 pair configurations.

[0018] While exemplary embodiments have been shown and described, various modifications and substitutions may be made thereto without departing from the spirit and

scope of the invention. Accordingly, it is to be understood that the present invention has been described by way of illustration and not limitation.